SECTION 1.0
EXECUTIVE SUMMARY
& INTRODUCTION

1.1 EXECUTIVE SUMMARY

The Acme watershed administrative unit (WAU) with a drainage area of 90 km^2 (36 mi^2) encompasses approximately the lower 20% of the entire South Fork Nooksack watershed (total area = 460 km^2, 186 mi^2). (See List of Figures at Page vii for locations of maps showing the Acme WAU.) The lower most portion of the South Fork Nooksack River flows through the Acme WAU, thus contains the largest floodplains and terraces within the larger South Fork Nooksack watershed.

The Acme WAU is used by a number of anadromous salmon including chinook, coho, pink and chum salmon, as well as steelhead and sea-run cutthroat trout. Resident cutthroat and rainbow trout are found throughout the WAU, and Dolly Varden (or bull trout) have been reported upstream of the WAU in the South Fork Nooksack River. No sightings of federally listed, threatened or endangered fisheries species in the WAU have been described in literature reviewed for this analysis or reported during interviews. Escapement trends for the South Fork Nooksack River indicate the spring chinook stock has a chronically low population level.

The pre-management forest in the uplands was dominated by western hemlock, Douglas fir, and western red cedar. Early reports (1883 and 1885) indicate that portions of the mountainous western side of the WAU had been recently burned by wildfire. On the valley floor, early surveys indicate that red alder, black cottonwood, bigleaf maple, Sitka spruce, and western red cedar dominated a "swamp". Harvest and clearing of timber on the valley floor probably began before the turn of the century with almost all original forests replaced by agriculture or regrowth by the late twentieth century. In the upland forest, commercial timber harvest began in earnest in the 1940s and continues to present. The majority of the conifer forests in the uplands is comprised of second growth ranging from 0-60 years of age.

The portion of the South Fork Nooksack River located in the Acme WAU is characterized by the lowest gradient of the entire South Fork Nooksack River system and is therefore a natural depositional area for sediment and wood originating upstream. As a consequence, the floodplain and terrace landform averages 5 km (2 miles) in width and comprises approximately 40% of the total area of the Acme WAU. Historically, the low gradient and unconfined character of the South Fork Nooksack River resulted in the deposition of numerous gravel bars which caused the river to have a braided and highly sinuous morphology. Early settlers (1800s) also reported the existence of extensive, river-spanning log jams in the lower south fork. The historical meandering of the river in conjunction with log jams and sediment deposition created numerous channels, many of which were abandoned by the river for periods of time. These abandoned river channels contained flow either from the South Fork, the mountain tributaries, or they were fed by floodplain groundwater.

The extensive floodplains, slough channels, riparian forests, and log jams all contributed to the development of high quality and quantity of fish habitat prior to the early 1900s. In particular, the numerous slough channels and backwater areas of the lower Nooksack River would have supplied major rearing habitat for juvenile salmon. In addition, the low velocity floodplain channels may have functioned as critical refuge habitats periodically during large floods when fish may have been displaced downstream from higher-gradient channels. Large gravel bars, their stability enhanced by large semi-permanent log jams, would have provided extensive spawning areas. Altogether, the Nooksack River and its floodplain slough channels, would have provided excellent spawning and in particular rearing habitat. Hence, the river (and its floodplain) was historically the major fish habitat feature in the Acme WAU. These floodplain habitat features have been all but eliminated by agricultural and flood control practices as discussed below.

Presently fish are found in the mainstem South Fork Nooksack River and in the lower portions of tributaries within the South Fork Valley. Approximately 90 percent of the fish-bearing stream length is located in residential and agricultural areas. A small portion (primarily Tinling Creek) extends into upland areas managed for forestry. Only minor spawning activity occurs in the WAU with most anadromous fish proceeding upstream to spawning habitat in the upper South Fork Basin. Although historically the WAU provided a greater quantity and quality of holding, spawning, and rearing habitat, it remains an important summer and winter rearing area and probably contains a relatively high number of the juvenile salmon and sea-run cutthroat trout over-wintering in the South Fork Nooksack River Basin.

Erosion in the steep upland areas in the Acme WAU is characterized by several types of mass wasting. The Chuckanut sandstone formation underlies steep terrain in the basins of Sygitowicz, Falls and Standard Creeks in the northwest, and the northern Van Zandt Dike area in the northeast and as a result shallow landsliding and debris flows are concentrated in those areas. Phyllite bedrock underlies the southern portion of the WAU and includes portions of McCarty and Jones Creek basins in the southwest, and south of Tinling Creek. Because of the weaker and more highly weathered phyllite bedrock, the southern portions of the basin are much less steep and contain little shallow landsliding and debris flows. However, the phyllite bedrock allows formation of deep-seated landsliding as encountered in the Jones Creek area.

One hundred and ninety-one landslides were inventoried in the Acme WAU that occurred between approximately 1970 and 1994. Almost all shallow landslides occurred within bedrock hollows, the topmost portions of first-order channels (commonly classified as type 5 streams), and steep inner gorges adjacent to upland streams. The highest landslide density occurred on hillslopes greater than 36 degrees (73%). Thirty-two percent of landslides were associated with clearcuts (presumably because of reduced rooting strength), 45% with logging roads (by failures of fills and rerouting of drainage), and 16% with mature forests (predominantly in inner gorges). Shallow landslides commonly triggered debris flows and dam-break floods (debris torrents) in steep mountain channels, including Sygitowicz, Standard, McCarty, Falls, Jones Creeks, and their tributaries. Debris flows and dam-break floods have deposited sediment and debris on most of the major alluvial/debris flow fans and on the terrace/floodplain of the South Fork.

Ten mass wasting map units were created in the Acme WAU to differentiate among areas in the watershed having different landslide processes, natural susceptibilities to failures, sensitivities to forestry practices, and delivery of sediment to streams or public structures. Several of the map units have a high susceptibility to failure and forestry activities in those locations can trigger landsliding; these are primarily convergent hillslopes greater than 30 degrees, although failure likelihood increases substantially as gradients exceed 35 degrees. One map unit contains deep-seated landslides and it is not certain how forestry activities affect those types of failures.

Surface erosion within recently logged areas is slight because of limited soil disturbance and high permeability soils. Gravel-surfaced logging roads generate and deliver substantial fine sediment, much of it generated during log truck traffic during rains, and delivered to channels through roadside ditches. The total amount of road sediment is relatively low because of low densities of active logging roads, except in the southern Van Zandt Dike, where the total sediment delivery from the mainline road (N-1000) and spur roads may be of a sufficient magnitude to contribute to turbidity and possibly sedimentation in the Black Slough. Erosion from pastures and fields in the South Fork valley stemming from agriculture and grazing is of a similar magnitude to the total amounts from the logging road network, sediment contributed from logging roads and agriculture both greatly exceed sediment from recent clearcuts.

Although mass wasting and other more continuous erosion processes in the subbasins of the Acme WAU (such as bank and surface erosion) deliver sediment to the South Fork Nooksack River, the majority of sediment supply originates from sources upstream of the WAU. The proportion of the total South Fork Nooksack basin sediment yield that originates from the Acme WAU was estimated to be approximately 10% or less.

The assessment of hydrologic change focused on the influence of forest cover removal on peak flows produced during rain-on-snow storms. The frequency of rain-on-snow events is low in the South Fork valley but relatively common in the eastern and western upland areas. Predicted increases in peak flows based on current forest cover conditions (1994) relative to fully forested conditions were 3%, 5% and 6%, for the eastern uplands, western uplands and Jones Creek basins respectively. Simulations of 100% clearcut conditions produced increases of 11%, 20% and 26% for eastern, western and Jones basins. It was not possible to detect in the field any effects of increased peak flows on channels and fish habitat because other processes such as debris flows, dam-break floods, channel aggradation (from sediment originating from mass wasting), and the absence or presence of large woody debris dominate channel characteristics.

The potential for flooding was evaluated in several tributaries and structures (roads, bridges, culverts) within the WAU, but not for the South Fork Nooksack River since most of its basin lies upstream of the Acme WAU. At public road crossings over Jones and Sygitowicz Creeks and several other channel sites, increased peak flows would be accommodated within the high flow banks of the channel. Historically, pulses of sediment and woody debris have reduced channel capacity which resulted in flooding over bank at those locations. Future flooding is likely to occur from similar causes. Of 19 culverts at smaller stream crossings, 15 were undersized for the 100-year peak flow as required by the current Hydraulic Code reflecting inadequate design and/or less stringent standards when they were installed.

Riparian conditions in the Acme WAU differ greatly between lands devoted to agricultural use (surrounding 89 percent of all fish-bearing streams) and lands devoted to forest practices. The majority of riparian stands in agricultural areas are comprised of young and sparse deciduous forests with corresponding low recruitment potential of large woody debris, low amounts of in-stream large woody debris, below- target riparian shade, and peak stream temperatures that exceed the Class A water quality criterion. Riparian stands located in lands devoted to timber production are predominantly forested with mature timber (88%). Prospects for recruitment of large woody debris are good in 57 percent and fair in 29 percent of these stands. Under appropriate management, all riparian stands on forested lands appear capable of supporting dense stands of late seral stage riparian forests and therefore good potential for recruitment of large woody debris. Eighty percent of fish-bearing streams in forest production lands presently have within-target riparian shade, as do 78 percent of the associated headwater Type 4 streams.

As previously mentioned, many of the mountain tributaries, including Sygitowicz, Standard, McCarty, Falls, and Jones Creeks, have had debris flows and dam-break floods that have scoured sediment and woody debris from along their main channels. In addition to fish habitat damage, these events present a risk to any people or properties located on the alluvial/debris flow fans at the base of most of the tributaries. Such debris fans existed long before land use in the area and are naturally hazardous locations, particularly following large forest fires or during intense winter rain storms. However, forestry activities can increase the frequency of debris flows and dam-break floods and therefore increase the risk to the alluvial/debris fans. This report includes forest practices prescriptions designed to reduce the impacts of forest practices in the future.

Debris flows and dam-break floods have also negatively impacted fish living in fan reaches and fish habitat in the mountain channels by reducing pool frequency and depth. However, mountain tributaries only contain the upper limit of fish habitat and hence the impacts to fisheries at the scale of the Acme WAU, or the entire South Fork watershed, were considered much less significant compared to the fishery impacts from agriculture and development on the Nooksack River and its floodplain. Several strategies were employed to increase land available for development and agriculture, and to combat flooding *on the South Fork Nooksack floodplain*, including: 1) the removal or burning in place of log jams to limit river braiding, meandering and the flooding of slough channels; 2) diking and associated straightening of the river to confine the South Fork Nooksack to a single channel and to limit floodwater access to the floodplain; and 3) filling in of floodplain slough channels to reduce floodwater access to the diked and protected floodplain.

An aerial survey in 1994 revealed that approximately 60% of the length of the South Fork Nooksack River in the Acme WAU had been diked. The dikes are typically located at the outside of meander bends where the river has the highest potential bank erosion. The construction of dikes at these locations result in limiting the migration of the river, decreasing the size of gravel bars located on the opposite side of the river, limiting the opportunity of the river to create secondary channels (i.e. braiding), limiting the formation of slough channels, and decreasing the opportunity for gravel storage. Furthermore, in 1994, there was not a single river-spanning log jam in the lower Nooksack River, reflecting the essentially 100% removal of large wood from the river since the late 1800s. A dramatic loss in the number of slough channels since 1938 (86% reduction) has occurred because of flood control efforts. In addition, the length of riparian forests along the South Fork have decreased by 35% since 1940 and the total area of the channels and gravel bars has decreased by approximately 40%. The primary loss in channel area is because of the reduction of gravel bars.

Floodplain modification may also contribute to an increase in flooding downstream of the Acme WAU. Limiting the access of floodwaters onto the floodplain of the Acme WAU may cause somewhat higher flood peaks to be propagated downstream. In addition, the lack of opportunity of gravel storage may increase gravel transportation to channels downstream where deposition may reduce channel capacity and increase flooding.

In addition to the floodplain impacts described above, surveys of fish habitat in tributary channels generally revealed low pool frequencies, shallow pools, and low amounts of large woody debris throughout the WAU. The poor fish habitat is primarily the result of debris flows and dam-break floods, channel simplification and the lack of large riparian trees along the lower portions of the mountain tributaries, such as in Sygitowicz, Standard, McCarty, Falls, and Jones Creeks. Relatively large amounts of fine sediment (<0.85mm) were measured in Sygitowicz and Toss Creeks and probably occur elsewhere and may result primarily from chronic landsliding, at least in some of the basins. Wood plays an important role in fish habitat in all channels, but the effect of wood on channel morphology is most important in the low gradient floodplain channels and least important in the steep mountain channels draining the uplands. High water temperatures from the lack of riparian shade in the Nooksack River and Black Slough may be negatively impacting fish also.

Management prescriptions were developed for the upland portions of the Acme WAU containing commercial forest lands to address the impacts (to fish habitat and alluvial/debris flow fans) resulting from mass wasting, lack of woody debris and shade, and surface erosion. Non-binding management recommendations were also developed for the floodplain areas of the WAU where the largest impacts to fish habitats have occurred. Refer to the synthesis and prescription section of the report for information on specific hazards, vulnerability and rule calls, and for management prescriptions.

1.2 INTRODUCTION

The following watershed analysis report has been prepared for the Acme Watershed Administrative Unit (Acme WAU) under Chapter 222-22-040(3) WAC. The watershed analysis was initiated by the Trillium Corporation, the owner of more than ten per-cent of the non-federal land within the WAU. In October of 1997, Crown Pacific Limited Partnership purchased the lands within the WAU previously owned by Trillium Corporation, at which time sponsorship of this watershed analysis shifted from Trillium Corporation to Crown Pacific Limited Partnership. Notice of commencement of watershed analysis was filed with the State Department of Natural Resources and sent to all forest land owners in the WAU, agencies, tribes and other interested persons on or about November 23, 1994. All modules and the prescriptions were prepared by certified watershed analysts (Table 1-1) using Level 2 methodologies. The analysis was performed under the Standard Methodology for Conducting Watershed Analysis (WFPB 1994), with the exercise of appropriate discretion by scientists to address site-specific issues, in accordance with Level 2 analysis methodology. The Acme analysis follows Version 2.1 (WFPB 1994), in effect at the time the analysis was initiated.

The Acme WAU (#01-08-11) consists of approximately 20,500 acres (82.9 km^2) located in Whatcom County, Washington, 13 miles east of Bellingham. The WAU boundaries were designated by the Department of Natural Resources, with later approved refinements prior to this analysis. The WAU consists roughly of the lower one-fifth of the total South Fork drainage area. The central 40% of the WAU consists of the agricultural South Fork Valley, which contains the towns of Acme and Van Zandt. The remaining upland terrain along both sides of the valley are used primarily for commercial forestry.

The purpose of this report is to provide documentation of the assessment of hillslope hazards (i.e. mass wasting, surface erosion, peakflows and riparian conditions), response segments (i.e. stream channels) and public resources (fisheries habitat, water supplies and public works). Narrative documentation of each of these "modules" is contained in Sections 3 through 9. The linkages identified between hazardous processes and vulnerable public resources are documented in Section 10, the Synthesis summary. Prescriptions for management are set out in Section 11. Following several Appendices is the SEPA Checklist. Map products are included in the main body of the report as 11x17 inch color figures and the same maps have been provided under a separate cover to the DNR at a scale of 1:24,000. Standard forms and worksheets are included with each module report, except where an alternative product is provided with justification.

To a greater degree than most WAUs, the Acme WAU contains substantial non-public resources, including homes and other private property, that are potentially affected by hillslope hazards. The protection of such non-public resources is beyond the scope of the regulatory framework for watershed analysis (see 222-22-010(1) WAC), which is limited to public resources. In many sub-drainages with the WAU the prescriptions required to protect public resources, such as fish habitat, will simultaneously reduce the hazard to private properties, especially those located near fish-bearing channels. At locations where hillslope operations threaten only non-public resources, the Acme prescription team recommends compliance with the same management prescriptions as would be applied if public resources were threatened. However, because the regulatory framework for watershed analysis limits application of mandatory prescriptions to protection of public resources, compliance with such prescriptions to protect private resources is on a voluntary basis only.

It is important to emphasize that the term "moderate" as it refers to hazard, vulnerability and resource sensitivity ratings within the modules, is synonymous with "medium" ratings designated in 222-22 WAC. Thus, moderate and medium ratings used in this report should be seen as interchangeable.

Care should be exercised in extrapolating the results of this analysis to locations outside of the Acme WAU. Because each watershed is topographically unique and has experienced a particular history in terms of management activities and climatic events, results from the Acme WAU may not be broadly applicable to other watersheds.

Table 1-1

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Table 1-1

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